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Front Cover: Mountain chameleon (*Chamaeleo montium*). A forest species from Cameroon, West Africa.
Photo by John Tashjian

Back Cover: Radiated tortoise (*Geochelone radiata*). An endangered Chelonian from southern Madagascar.
Photo by Sean McKeown.

CAN WE SAVE KEMP'S RIDLEY SEA TURTLE? BELIEVE IT OR NOT!

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INTRODUCTION

Kemp's ridley, Lepidochelys kempi (Fig. 1), is the smallest and rarest of the sea turtles, with an adult weight near 45kg (Bjorndal and Balazs, 1983). It has been classified since 1973 as endangered under the U.S. Endangered Species Act and by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Kemp's ridley nests in aggregations called arribadas (arrivals) only along a 20km stretch of Mexican beach (Fig. 2) bordering the western Gulf of Mexico near Rancho Nuevo, in the State of Tamaulipas (Chavez, Contreras, and Hernandez, 1968). Now fewer than 600 females nest there during an entire season (Pat Burchfield, Gladys Porter Zoo, Brownsville, Texas, personal communication, June 1986) as compared to an estimated 40,000 in one day during the 1947 nesting season (Carr, 1963; Hildebrand, 1963; Marquez, 1983). Kemp's ridley nests sporadically on other beaches bordering the western Gulf of Mexico (Werler, 1951; Rabalais and Rabalais, 1980).

The nesting season for Kemp's ridley at Rancho Nuevo is April through July (Chavez et al., 1968; Pritchard and Marquez, 1973; Casas-Andreu, 1978). The females nest during the day, taking less than one hour to leave the water, crawl up the beach, dig a nest in the sand, deposit the eggs, fill and tamp the nest, and return to the water (Pritchard and Marquez, 1973). Some nest more than once during a season at Rancho Nuevo, but not all Rancho Nuevo females nest there every year (Marquez, 1983). Either some of the females do not nest at all in some years, or they nest elsewhere.

At Rancho Nuevo, the eggs of Kemp's ridley average slightly less than 40mm in diameter, and clutch size ranges from 54-185 eggs per nest, with an average near 110 (Chavez et al, 1968; Pritchard and Marquez, 1973). Incubation period is 50-70 days at Rancho Nuevo, with most emergences within 53-56 days of nesting. Hatchlings at Rancho Nuevo range in weight from 14-21g (Pritchard and Marquez) probably is not reached before six years of age in the wild (Brongersma, 1972; Pritchard and Marquez, 1973).

A number of factors may have contributed to the precipitous decline in the number of Rancho Nuevo nesting females, but man seems to be the worst enemy of Kemp's ridley. Excessive exploitation of the eggs and turtles for food or commercial products perhaps represents the major cause of the decline. Sea turtles are well suited for oceanic existence, but their nesting habits make the adult females and their eggs particularly vulnerable to human exploitation and natural predation. At Rancho Nuevo, Kemp's ridley eggs are eaten by coyotes and ghost crabs (Pritchard and Marquez, 1973). Hatchlings are exposed to a variety of mammalian, avian, and crustacean predators as they crawl down the beach to the water as well as predatory fish after they enter the ocean (Hildebrand, 1963; Pritchard and Marquez, 1973). Juveniles and adults probably succumb to large predators such as sharks (ibid.).

Some of the sea turtles that are captured unintentionally in shrimp trawls die, but methods have been developed to resuscitate and release turtles that happen to get caught in this way (Watson and Seidel, 1980). Also, the National Marine Fisheries Service (NMFS) has developed a Turtle Excluder Device or TED (Fig. 3) that allows captured turtles to escape the trawl (Taylor et al., 1985). As a fringe benefits, the TED reduces the incidental catch of finfish without reducing the catch of shrimp, so it also is called a Trawling Efficiency Device. Mandatory use of TEDs in shrimp trawls was initiated for the first time in 1986; their use meets one of two alternative conservation measures required to reduce sea turtle mortality in waters open to shrimping beyond 15 nautical miles off the Texas coast during the Texas Closure (when portions of the Texas coast are closed to shrimping for 45-60 days in spring/summer) (Department of Commerce, 1986).

Because Kemp's ridley seemed to be approaching extinction, Mexico initiated a national conservation program at Rancho Nuevo in the mid-1960's. This was extended to international status in 1978 when the United States Fish and Wildlife Service (FWS), the National Park Service (NPS), the NMFS, and the Texas Parks and Wildlife Department (TPWD) joined with Mexico's Instituto Nacional de la Pesca (INP) in a cooperative conservation program which has three objectives (Klima and McVey, 1981):

(1) Protection of the nesting turtles and their eggs at the beach near Rancho Nuevo,
(2) evaluation of head starting, and
(3) establishment of a new nesting colony at the NPS' Padre Island National Seashore near Corpus Christi, Texas, using the working hypothesis that imprinting takes place in the eggs and/or hatchlings.

This paper describes the head starting project for Kemp's ridley, which involves collecting eggs, "imprinting" eggs and/or hatchlings, rearing turtles in captivity to the yearling stage, then tagging and releasing the survivors into the Gulf of Mexico to increase their survival during the critical first year of life. The Kemp's ridley head start research project is a 10 year feasibility study, now in its ninth year.

HEAD START METHODS

Collection and Incubation of Eggs

At the beach near Rancho Nuevo, plastic bags are used by biologists of the FWS and Gladys Porter Zoo (Brownsville, Texas) to catch the eggs as they emerge from the cloacas of nesting females, so the eggs do not come in contact with Rancho Nuevo beach sand (Klima and McVey, 1981; Caillouet, 1984; Fontaine et al., 1985). Usually 2,000 of an estimated 70,000-90,000 eggs laid during a nesting season at Rancho Nuevo are taken for head starting each year (Jack Woody, FWS, Albuquerque, NM personal communication, October 1985).

The eggs are transferred to polystyrene foam boxes containing Padre Island sand, one clutch per box, and transported by aircraft to the Padre Island National Seashore where NPS biologists oversee their incubation in the boxed sand (Fig 4; Klima and McVey, 1981; Caillouet, 1984; Fontaine et al., 1985). Sex in sea turtles is influenced by incubation temperature, with warmer temperatures favoring the production of females (Yntema and Mrosovsky, 1980; Morreale et al., 1982; Standora and Spotila, 1985). Therefore NPS biologists control the temperature in the hatchery to produce a preponderance of female hatchlings (Milford Fletcher, NPS, Santa Fe, NM, personal communication, March 1986).

HATCHLINGS

After the hatchlings emerge (Fig. 5), they are taken to the north Padre Island beach at the National Seashore and released to crawl down into the surf (Klima and McVey, 1981; Caillouet, 1984; Fontaine et al., 1985). The hatchlings are then netted from the surf, put into boxes (Fig. 6), and transported by aircraft or vehicle to the NMFS Southeast Fisheries Center (SEFC) Laboratory in Galveston, Texas.

It is hypothesized that the turtles become imprinted as embryos in the eggs while exposed to the beach sand in the boxes during incubation and as hatchlings crawling on the beach sand and swimming briefly in the surf (Klima and McVey, 1981; Owens, Grassman, and Hendrickson, 1982; Grassman et al., 1984).

REARING METHODS AND FACILITIES

Because young Kemp's ridleys are very aggressive, they cannot be reared together in groups (Fig. 7; Klima and McVey, 1981; Caillouet, 1984; Fontaine et al., 1985). They bite and injure one another, the injuries become infected, and this results in poor health and death in some cases (Clary and Leong, 1984). The turtles thrive when reared individually.

Hatchlings are not fed for about 1-2 weeks after emergence to allow time for absorption of the yolk sack (Fontaine et al., 1985). Though the natural diet of Kemp's ridley consists of crustaceans such as crabs, and fish, jellyfish, and molluscs (Pritchard and Marquez, 1973), the turtles are fed a modified Purina trout chow (a dry floating, pelletized diet) in captivity. Each turtle receives a measured quantity of this nutritious food, usually twice each day. The daily amount of food per turtle is adjusted monthly, based on a percentage of the average weight of a monthly sample of the turtles. Hatchlings receive a daily amount of food approximately equal to 5% of their body weight. The percentage is decreased gradually until the turtles are receiving an amount approximately equal to 1.5% of their body weight as yearlings.

The turtles are housed in two metal-framed quonset huts (approximately 9 X 29m; Fig. 8), each covered by double layers of white, semi-opaque, polyethylene sheathing separated by compressed air supplied by blowers (Fontaine et al., 1985). The rearing tanks (Fig. 9), made of fiberglass and rectangular in shape (approximately 2 X 6m), are each filled with about 3,100 liters of seawater and are supported by a sand floor. They are oriented approximately north and south on their long axes, and side by side in a linear array from east to west, each with a walk-space around them. They are numbered 1-15 from east to west (10 in the east quonset hut and 5 in the west quonset hut).

Within most of the tanks, 108 yellow plastic buckets (Fig. 10), each containing about 10 liters of seawater, are arranged in 6 columns and 18 rows (Fig. 9; Fontaine et al., 1985). The bottoms of the buckets are perforated with holes to allow exchange of seawater and liberation of turtle excrement and uneaten food. Some turtles outgrow these buckets in less than one year, and there is concern that the buckets may not allow adequate space for yearlings to exercise. Therefore, yellow plastic cartons (Fig. 11) are being tested and compared with the buckets as rearing containers. A rearing tank can hold 80 cartons assembled in units of 10 cartons connected together and lined with white plastic walls. The cartons are arranged in 5 columns and 16 rows within a tank. Each carton is submerged to contain about 20 liters of water. The cartons provide more space per turtle than do buckets, and therefore allow greater latitude of movement and exercise for the turtles. Bucket and carton codes (based on location by tank, row and column) are used as identification numbers for the turtles to keep track of the clutch identity of each turtle. Therefore, each clutch can be linked through records to the female that laid it.

Seawater for head starting Kemp's ridleys is obtained from the Gulf of Mexico by suction-pumping through well points buried in the sand below the surf (Fontaine et al., 1985). It is pumped into a concrete sump (113,000 liters) to allow settling of particulates, and then pumped into two, fiberglass-lined, redwood reservoirs (each 95,000 liters). Both by gravity flow and by pumping, the seawater is transferred from the redwood reservoirs to two fiberglass reservoirs (each 38,000 liters) located near the quonset huts (Fig. 8A). The contents of the fiberglass reservoirs can be pumped or drained into four smaller fiberglass reservoirs (each 28,000 liters) equipped with immersion heaters that warm the seawater during winter. As needed, seawater can be drained or pumped from the two larger reservoirs or from the four smaller reservoirs into the rearing tanks. Forced-air furnaces heat the air in the huts during winter (Fig. 8B).

Rearing tanks are drained, flushed by hosing with fresh (tap) water, and refilled with clean seawater thrice each week (Fontaine et al., 1985). Once each week, all the rearing tanks are scrubbed with brushes after draining to remove attached algae, uneaten food, and excrement. Wastewater drained from each rearing tank is collected in a concrete trough running along its south side; the wastewater then flows into a sump from which it is pumped into two 45,000 liter aeration tanks. After a 20 hour period of aeration, the water is dumped into the municipal sewerage system.

GROWTH AND SURVIVAL

Growth and survival during head starting have been described by Caillouet and Koi (1985) and Caillouet et al. (MSa). Figure 12 depicts the fitted curves describing exponential growth during the head starting of year-classes 1978-1985.

Survival during the first year of life in captivity averages better than 85% (Fontaine et al., 1985; Caillouet et al., MSa.).

TAGGING

At the age of one year or less, turtles are tagged and released into the Gulf of Mexico in hopes that some will survive and instinctively return to Padre Island to reproduce (Klima and McVey, 1981; Caillouet, 1984; Fontaine et al., 1985). The turtles are tagged so that they can be identified as head started individuals by year-class and clutch. At least one tag must be retained by the turtle (and be recognized as a tag by those who examine the turtle) so it can be identified as head started.

The standard tag for head started Kemp's ridleys has been a metal tag attached to the trailing edge of a front flipper of each turtle (Fig. 13) about one month before each year-class is released (Fontaine et al., 1985). Some turtles also have been marked with "living tags" formed by excision and transplantation of a 2-3mm sliver of light colored plastron tissue to a scute on the darker carapace (Fontaine and Caillouet, 1985; Caillouet et al., 1986b). Living tags are implanted on turtles usually between five and nine months of age, before the carapace has hardened, although hatchlings a few days old have been living-tagged experimentally (Caillouet et al., 1986b). All members of a year-class are marked on the same carapace scute, and a different scute is selected each year to represent different year classes (Caillouet et al., 1986a). A binary-coded, magnetic metal tag 2mm long has been implanted near the distal end of a front flipper of all head started turtles of the 1984 and 1985 year-classes within about two months of their release. Multiple marking increases the probability of retention of at least one recognizable tag. Experimentally, flipper prints have been made of a number of Kemp's ridleys held in captivity (Caillouet et al., MSb). Multiple-marked and flipper-printed Kemp's ridleys are being held in captivity beyond the first year, in part to study tag retention and recognition.

RELEASE

More than 10,700 Kemp's ridleys representing year-classes 1978-1985 have been head started, tagged, and released into the Gulf of Mexico. Most have been released offshore of Padre and Mustang Islands near Corpus Christi, Texas (Caillouet et al., 1986b). Some have been released off the upper Texas coast, in the Bay of Campeche, Mexico, off the western and southwestern coasts of Florida, and in Nueces and Copano Bays near Corpus Christi. Reports of recoveries of tagged individuals demonstrates survival, adaptation, and wide dispersal throughout the Gulf of Mexico, along the Atlantic coast of the U.S. to New England, with three reported as far away as the European Atlantic coast, France, and Morocco (McVey and Wibbels, 1984; Wibbels, 1984; Fontaine et al., Ms).

CAPTIVE PROPAGATION

Head started Kemp's ridleys have been distributed to cooperating organizations including Pan American University (South Padre Island,, Texas), Sea Turtle Inc. (South Padre Island, Texas), Sea-Arama Marine World (Galveston, Texas), Dallas Aquarium (Dallas, Texas), Marine Life Park, Inc. (Gulfport, Mississippi), Bass Pro Shops (Springfield, Missouri), Gulfarium (Fort Walton Beach, Florida), Clearwater Marine Science Center (Clearwater, Florida), Miami Seaquarium (Miami, Florida), Theater of the Sea (Islamorada, Florida), Marineland, Inc. (St. Augustine, Florida), Sea World of Florida (Orlando, Florida), North Carolina Marine Resources Center (Kure Beach, NC), New England Aquarium (Boston, Massachusetts), and Cayman Turtle Farm [1983] Ltd. (Grand Cayman Island, BWI). Currently, 114 such Kemp's ridleys, ranging from 2 to 8 years of age, remain alive. All of these organizations provide holding facilities for Kemp's ridleys older than one year, but only the Cayman Turtle Farm has facilities large enough and equipped properly for captive propagation.

In May 1984, eggs were laid by two of the captive-reared females, then five years old, at the Cayman Turtle Farm (Wood and Wood, 1984). Only three eggs hatched, indicating that copulation with and fertilization by captive-reared males had taken place, but the hatchlings died. These nestings represented the earliest documented age for maturation and nesting in the species, albeit in captivity. In May 1986, four nestings took place among the Kemp's ridleys, then seven years old, at the Cayman Turtle Farm (James Wood, personal communication, July 1986). At the time of this writing, more than 60 apparently healthy hatchlings had emerged and additional eggs were being incubated in hopes that more hatchlings would emerge and survive. With this successful hatch, captive propagation of Kemp's ridley became a reality for the first time.

THE FUTURE

Without international and intranational cooperation among government agencies, researchers, conservation organizations, herpetological societies, and the public, continued conservation and management of Kemp's ridley would not be possible. Of major importance is protection of the nesting turtles and their eggs at Rancho Nuevo through patrols by Mexican military personnel and by international teams of biologists and volunteers during the nesting and hatching seasons. Such efforts at Rancho Nuevo have virtually eliminated poaching and dramatically reduced predation to the points where these losses are inconsequential and no longer prevent Kemp's ridley recovery (Jack Woody, FWS, personal communication, January 1986). Marketing of the sea turtles and their products is being reduced, which should help the population recover. The U.S. and some other nations prohibit capture and possession of sea turtles and have banned commercial use, importation, and exportation of sea turtles and their products, whether caught or produced by turtle farms. Expansion of the use of the TED in U.S. and Mexican waters should reduce the incidental catch of Kemp's ridleys by shrimpers.

Head starting, based on a small fraction of the eggs produced at Rancho Nuevo each year, not only provides an annual increment of thousands of yearlings to the Gulf of Mexico, but also a supply to expand the captive stock of breeders as a "safety net" for the species. Captive breeding could complement other conservation efforts but should by no means be construed as replacing them. Head starting Kemp's ridleys in captivity provides opportunities for research leading to a better understanding of the biology of this species.

Head starting will be considered a full success only when surviving adults return to nest, especially if they nest where they were "imprinted" as hatchlings. However, the effects of human care could have some lasting influences on the behavior of head started turtles that might make them more susceptible to natural predation or recapture by man, or less adept at obtaining food or in navigating than their completely wild counterparts. If Kemp's ridley sea turtles, marked or unmarked, begin showing up in greater numbers to nest at Rancho Nuevo, at the Padre Island National Seashore, or elsewhere, this will indicate that conservation efforts are succeeding.

Will we be successful in preventing extinction of Kemp's ridley? Maybe so, maybe not. In the interim, the efforts of many are being dedicated to that cause. Only time will tell.

ACKNOWLEDGEMENTS

Head starting and transfers of head started Kemp's ridleys are made possible through permits issued by the Mexican and U.S. governments, the States of Texas and Florida, and CITES. Many individuals, in addition to the staff of the NMFS Head Start Research Project, have played major roles in the international Kemp's ridley recovery program, including Rene Marquez Millan (INP), Jack Woody (FWS), Milford Fletcher (NPS), Fred Berry (NMFS), and their staffs. Carole Allen, Chairwoman, and members of HEART (Help Endangered Animals-Ridley Turtles), a special committee of the Piney Wood Wildlife Society of North Harris County College, Houston, Texas, deserve special recognition for their preserving efforts in promoting public awareness and support of the Head Start Research Project. We greatly appreciate the support of herpetological societies throughout the U.S. and in a number of other countries.

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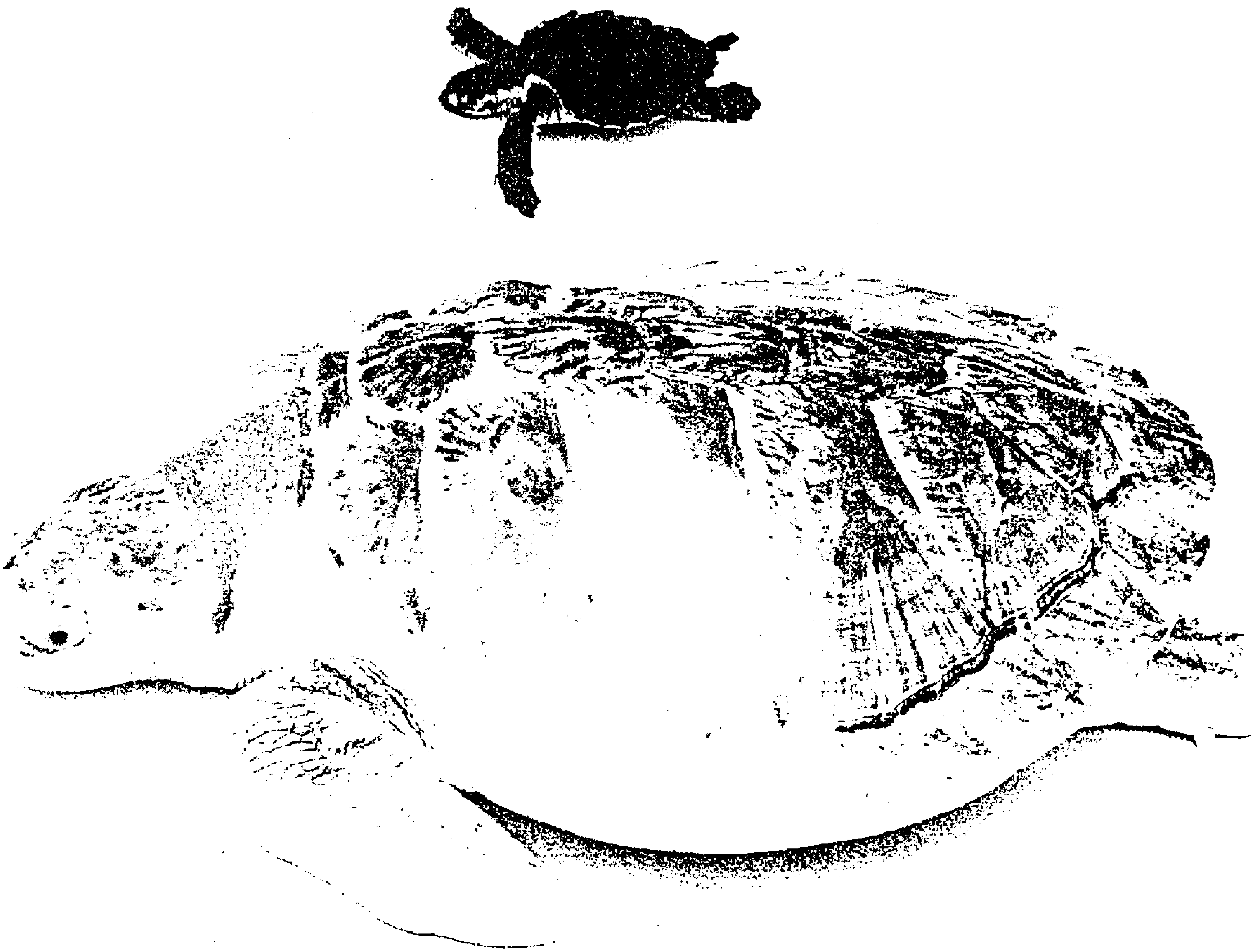


Figure 1. Kemp's ridley sea turtle (Lepidochelys kempi) yearling (above) and small adult female (below, about 31 kg). Photo by Daniel Patlan.

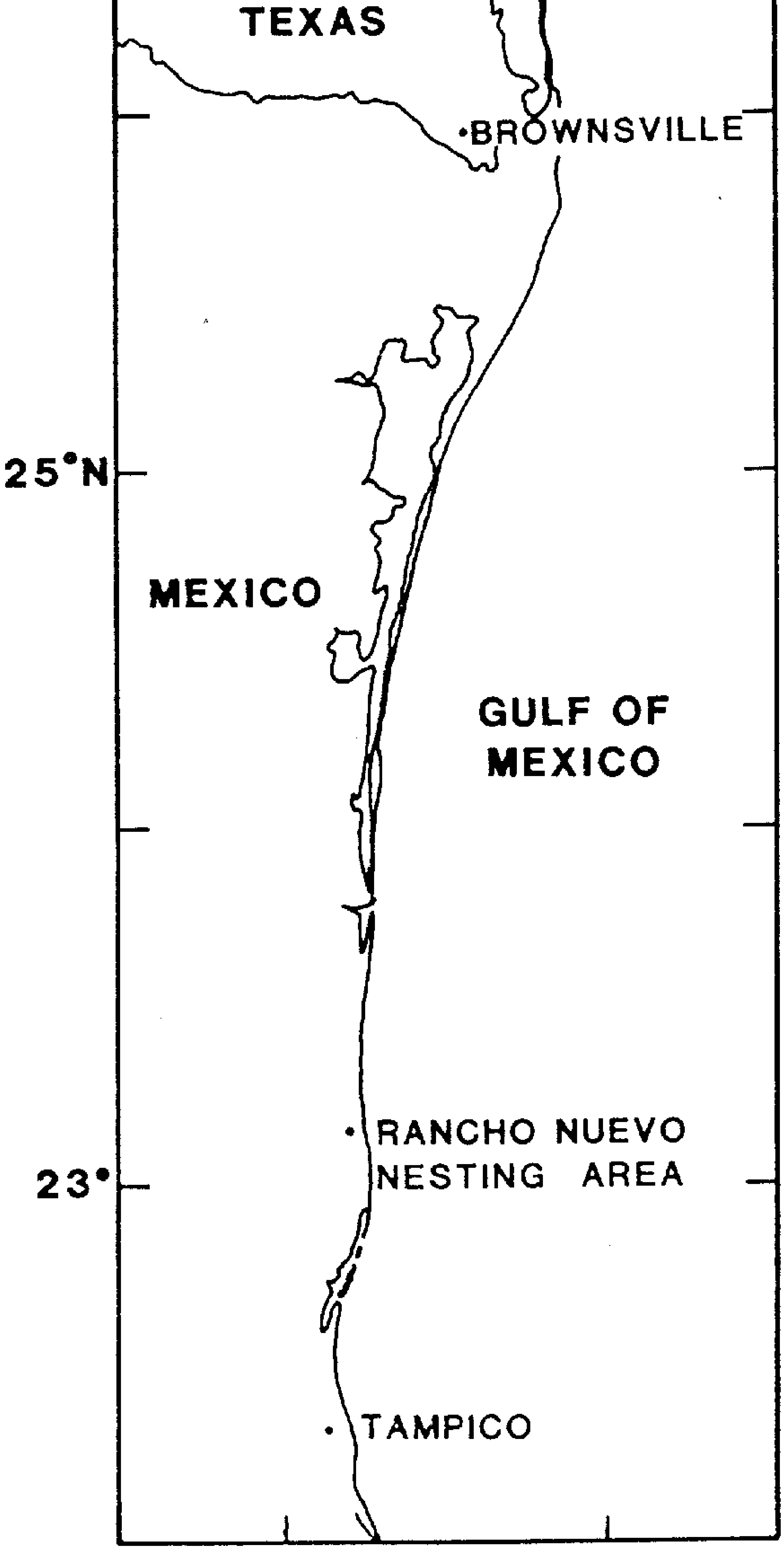


Figure 2. Location of the principal nesting area for Kemp's ridley sea turtle (Lepidochelys kempi). Adapted from Thompson, Henwood and Stuntz (MS).

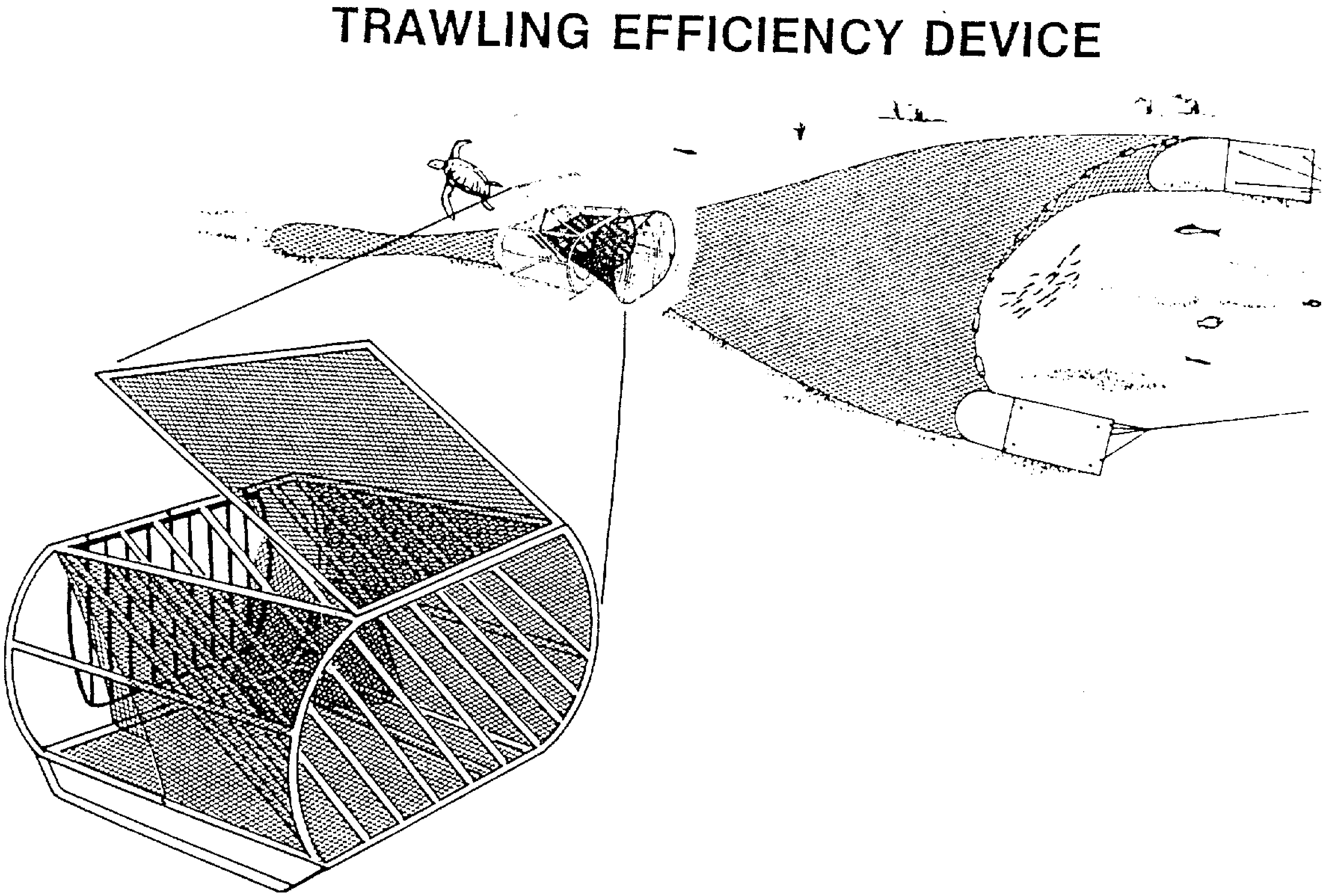


Figure 3. Turtle Excluder device (TED) shown in cutaway diagram of a shrimp trawl containing an escaping sea turtle (from Taylor et al. 1985).

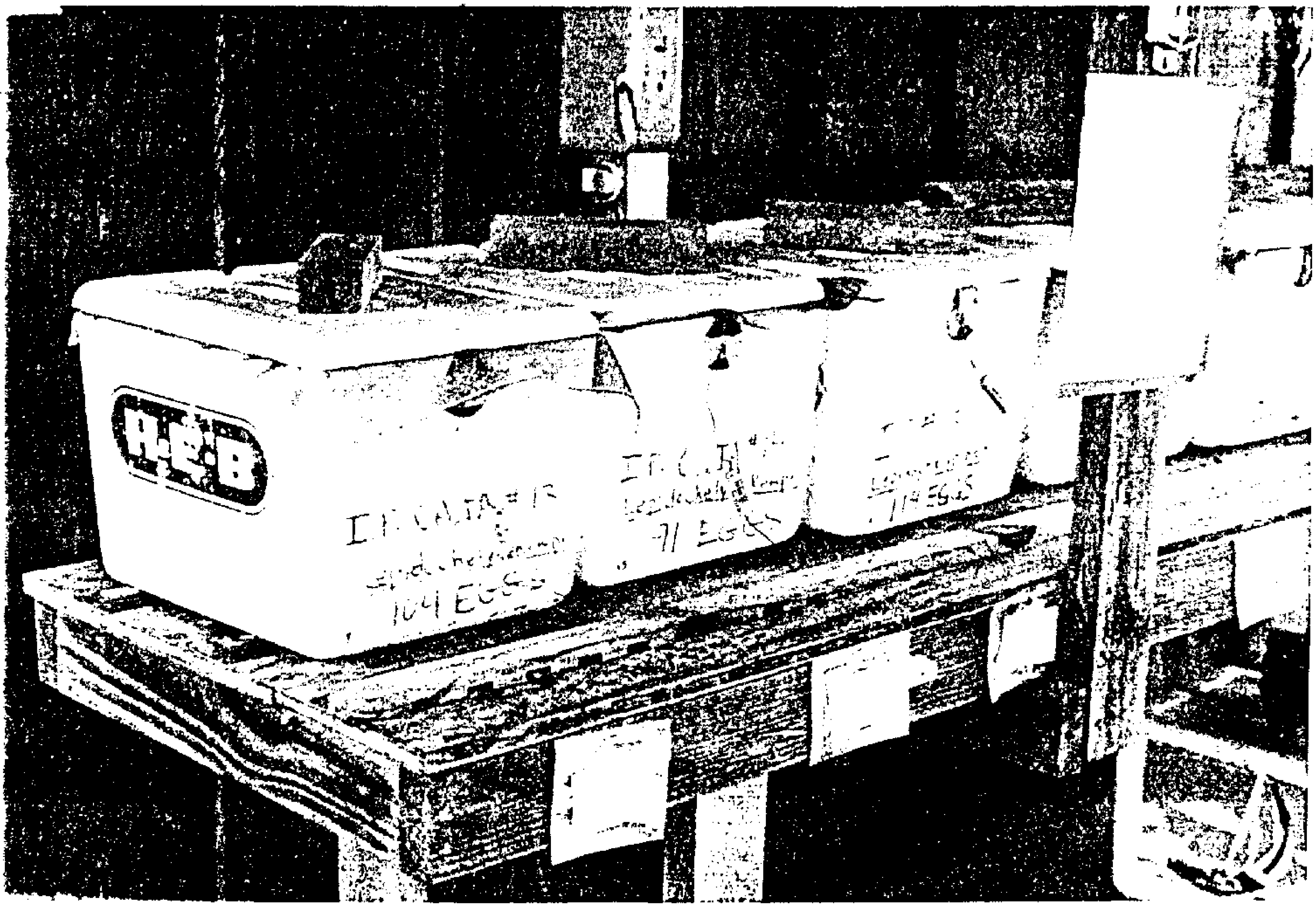


Figure 4. Polystyrene foam boxes containing Kemp's ridley sea turtle (*Lepidochelys kempi*) eggs being incubated at the NPS hatchery at the Padre Island National Seashore near Corpus Christi, TX. Note the wires attached to thermosensors in the boxes.

Figure 5. Kemp's ridley sea turtle (Lepidochelys kempi) hatchlings emerging from boxed sand at the NPS' Padre Island National Seashore near Corpus Christi, TX. Photo by Charles Caillouet.

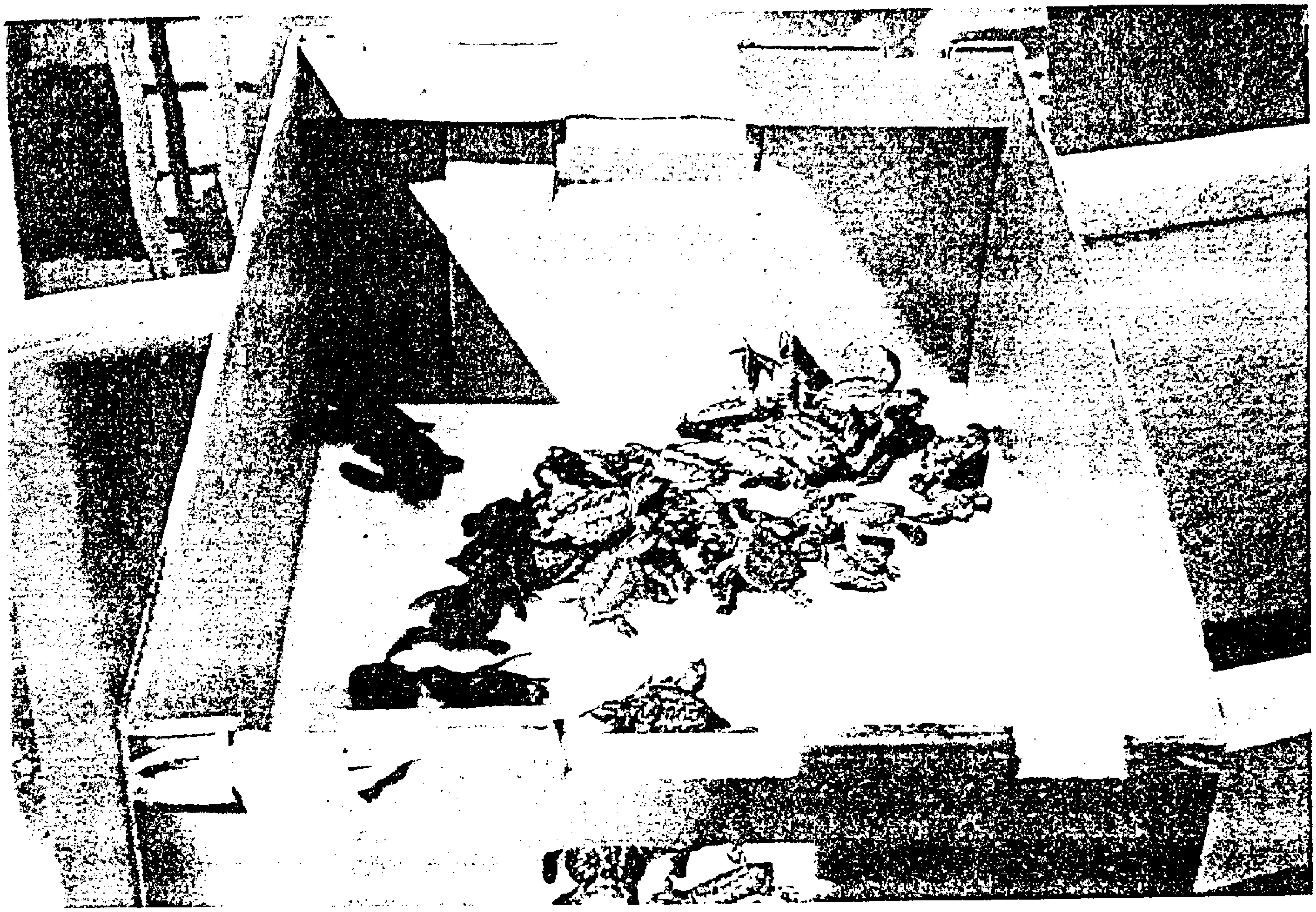
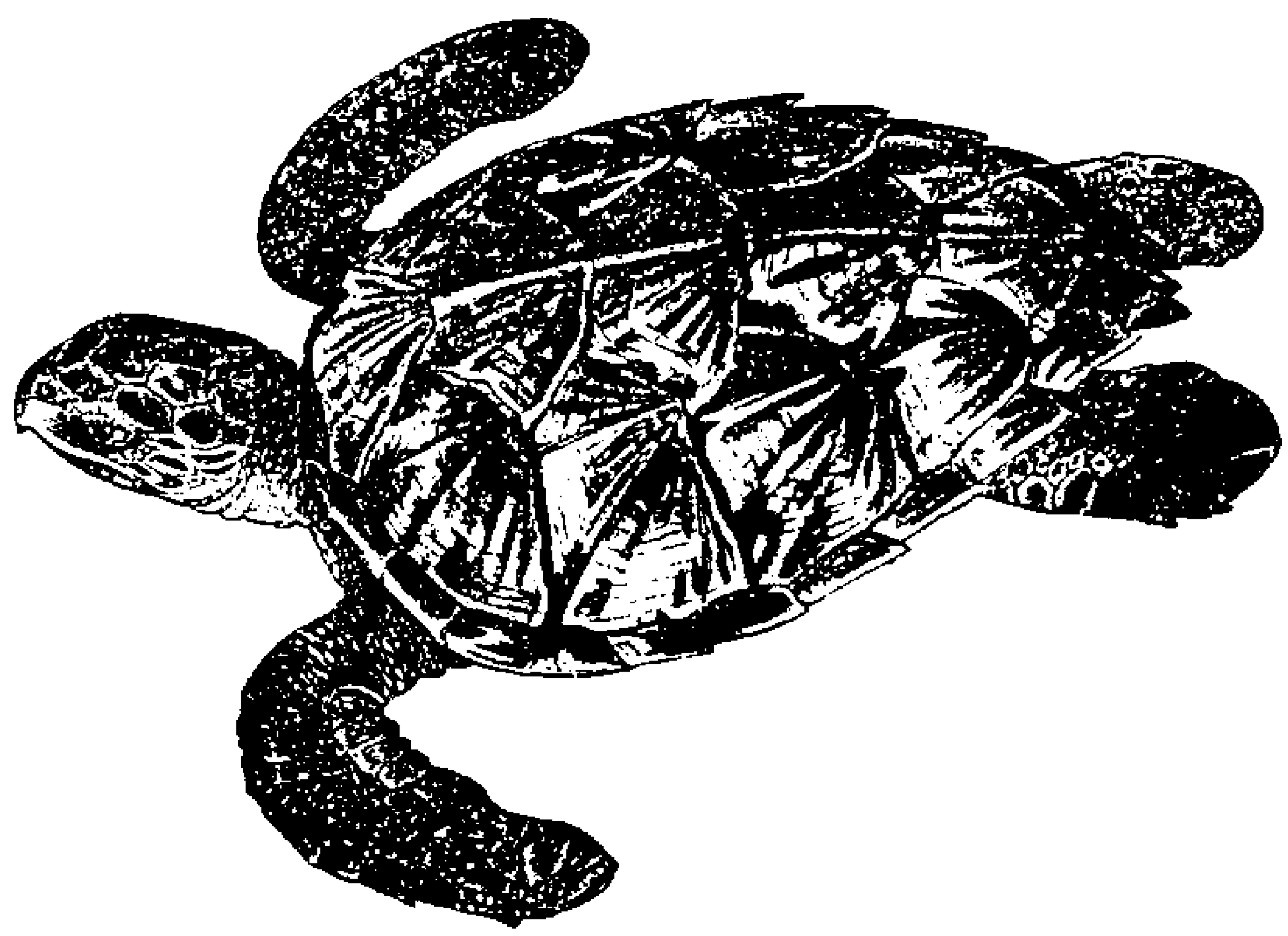


Figure 6. Kemp's ridley sea turtle (Lepidochelys kempi) hatchlings in waxed cardboard box following "imprinting" and transfer to the NMFS SEFC Galveston Laboratory, Galveston, TX. Note the polyurethane foam cushion that is moistened with seawater to prevent dessication of hatchlings during transport.



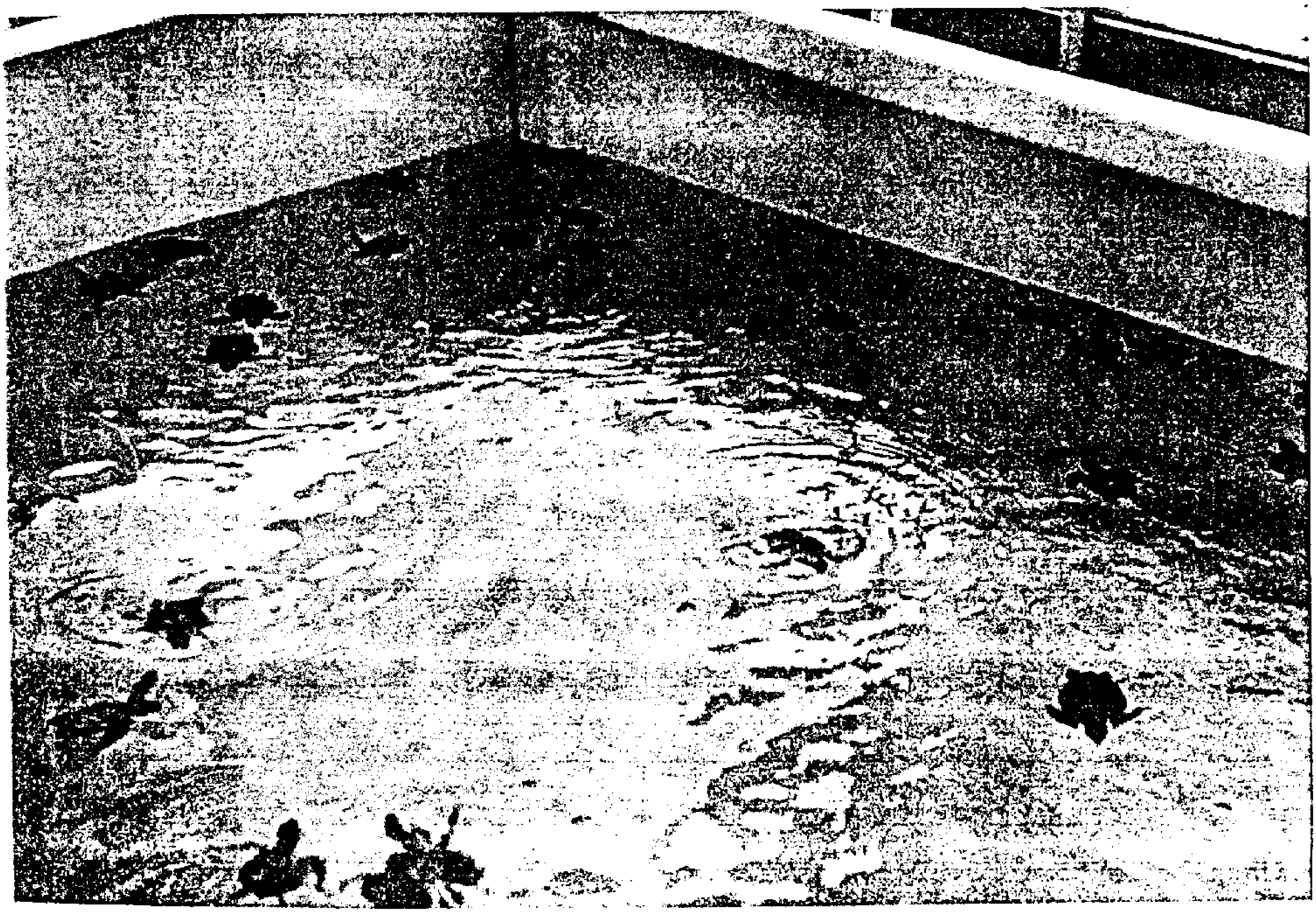


Figure 7. Attempts at rearing Kemp's ridley sea turtle (Lepidochelys kempi) in groups failed because the aggressive turtles bit and injured one another, even as hatchlings, and many died.

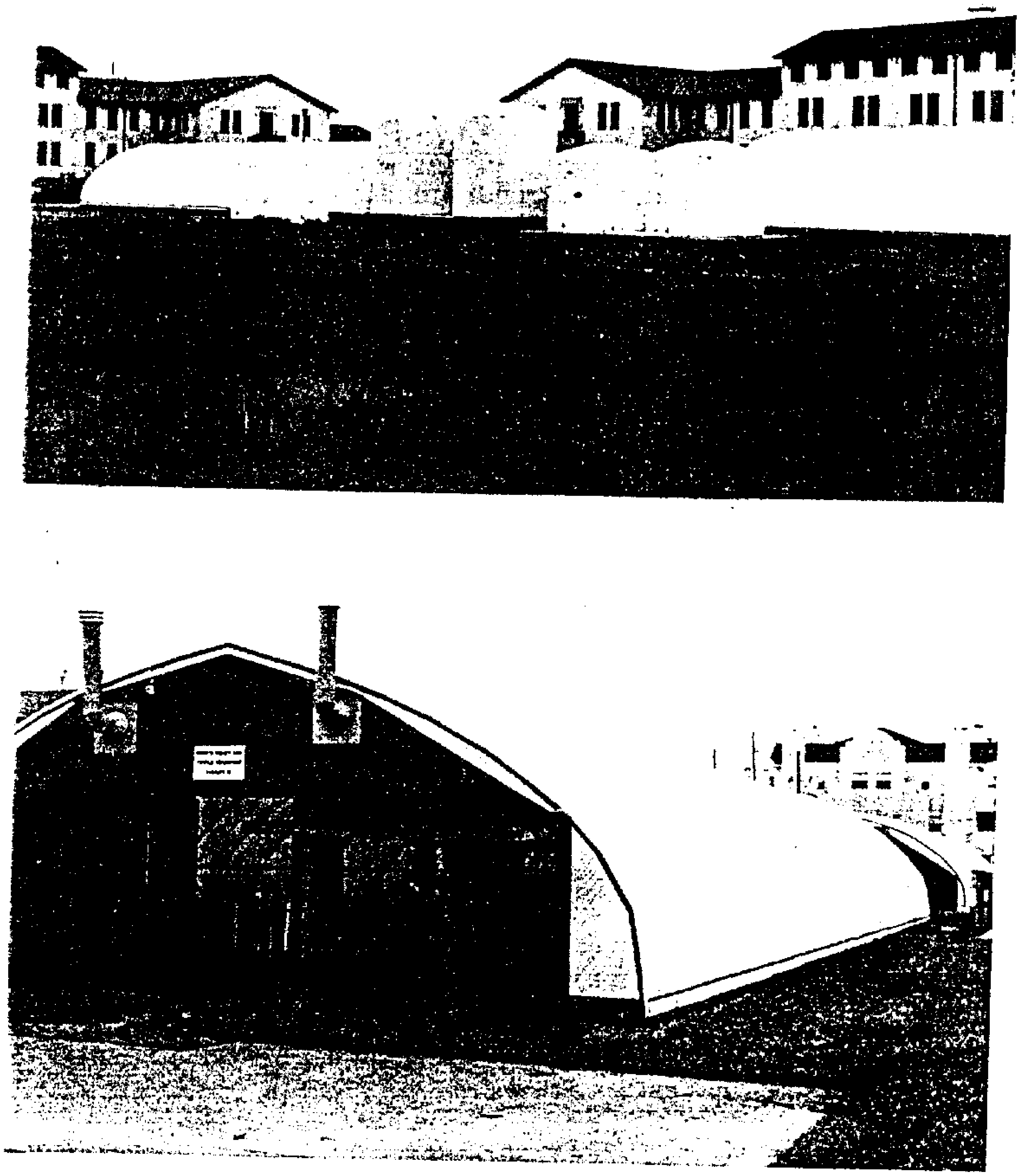


Figure 8. Sea turtle head start research facilities (quonset huts) at the NMFS SEFC Galveston Laboratory, Galveston, TX. A. West (far left) and East (far right) quonset huts and six seawater reservoirs (middle). B. Front of east quonset hut showing forced-air heater vents (top left).

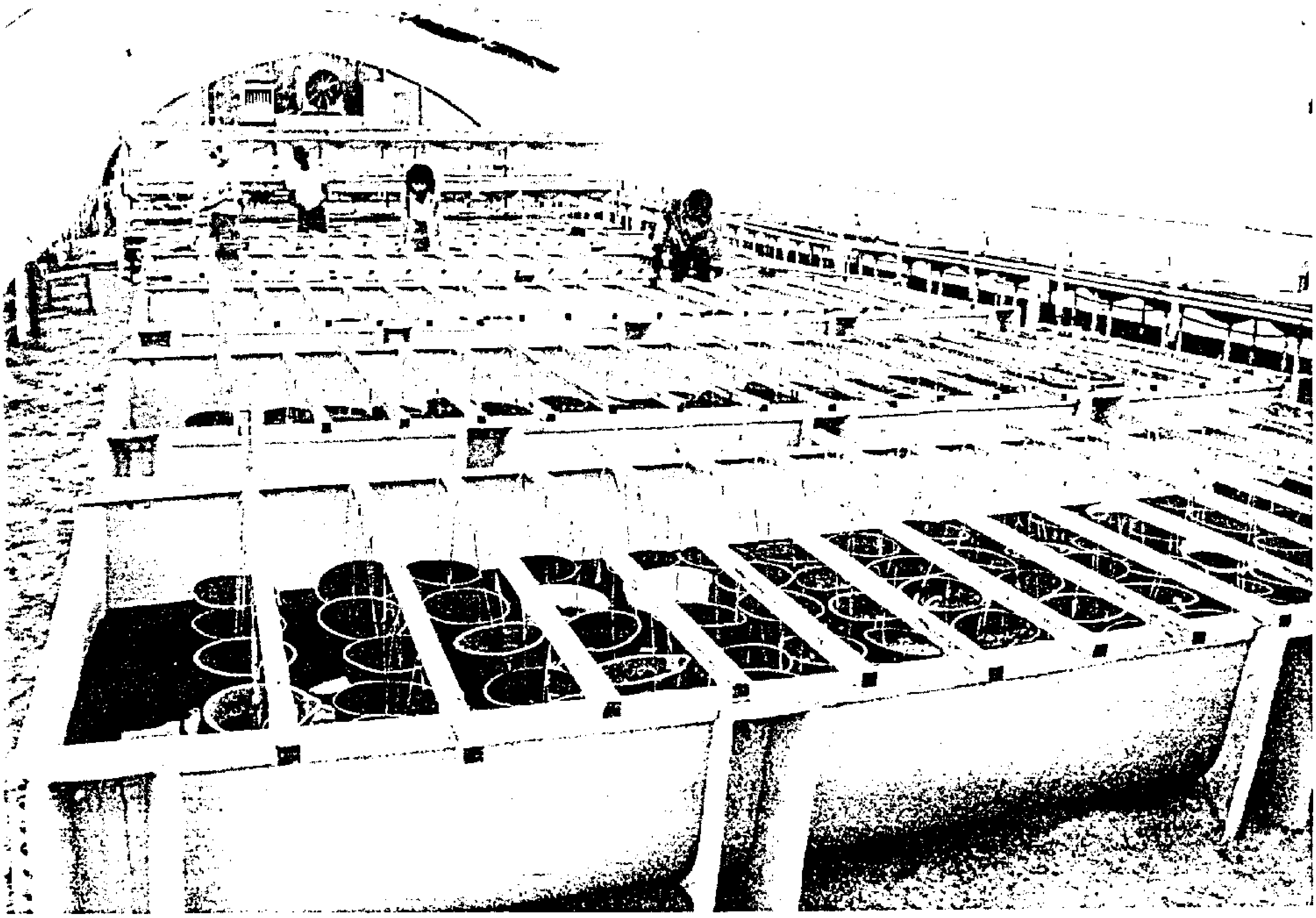


Figure 9. Kemp's ridley sea turtle (Lepidochelys kempi) rearing tanks (containing suspended buckets) at the NMFS SEFC Galveston Laboratory, Galveston, TX. Each turtle is reared in isolation from others within these yellow plastic bucket, because the species is aggressive.

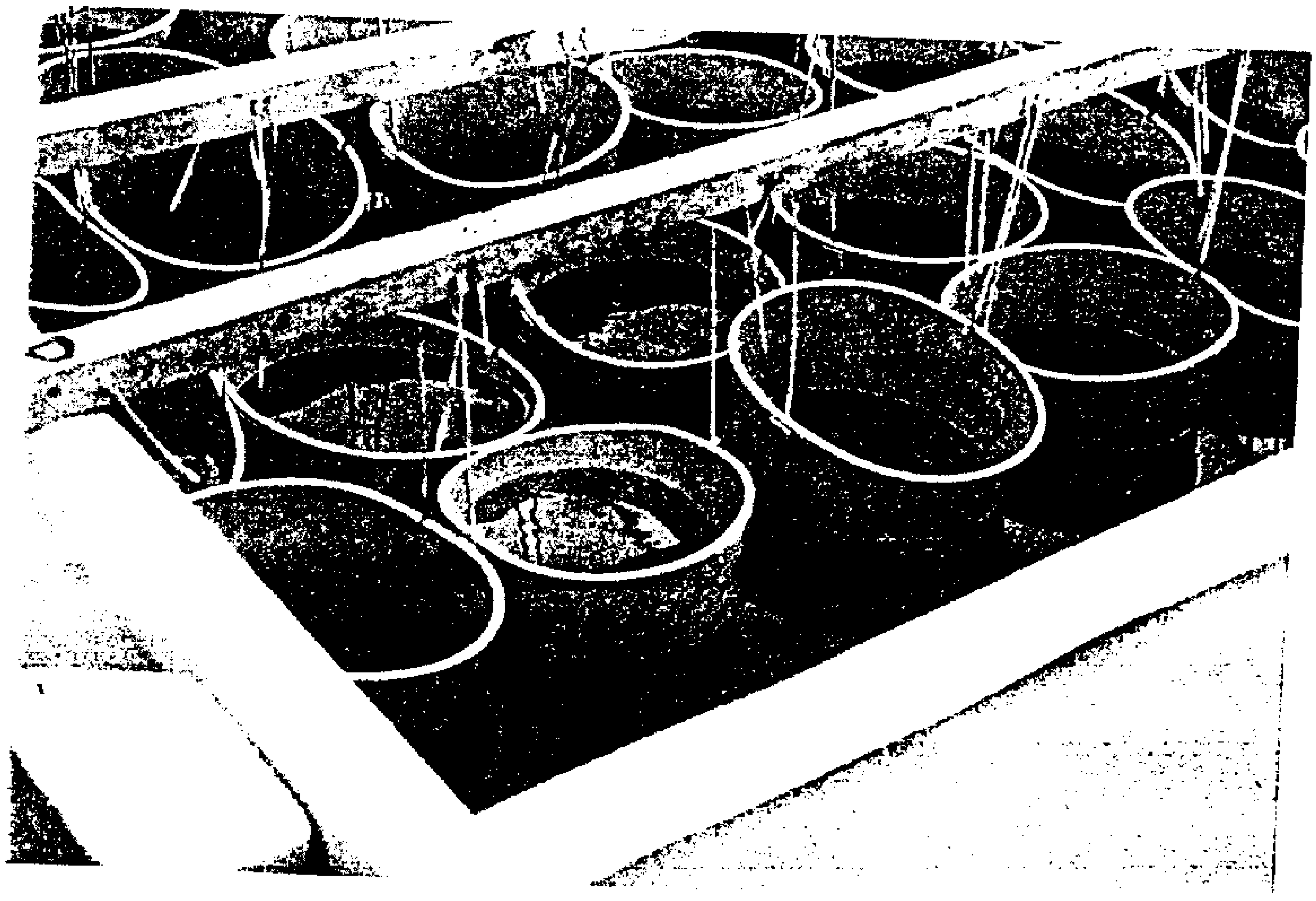


Figure 10. Rearing buckets, each contianing a hatchling Kemp's ridley sea turtle (*Lepidochelys kempi*) at the NMFS SEFC Galveston Laboratory, Galveston, TX.

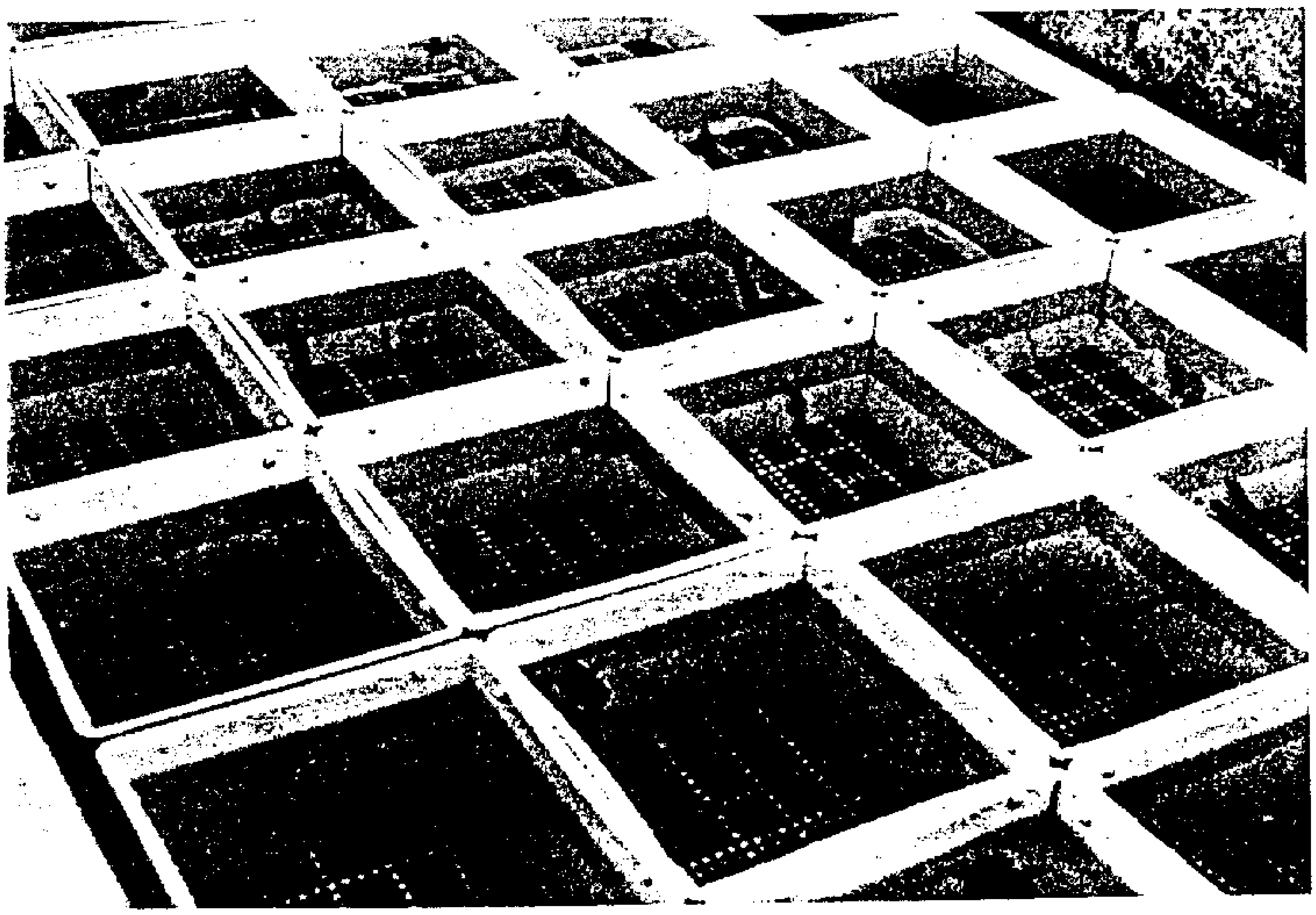


Figure 11. Yellow plastic cartons lined with white plastic sheathing are being tested for rearing Kemp's ridley sea turtle (Lepidochelys kempi) at the Galveston Laboratory, Galveston, TX. The cartons are bolted together in units of 10 with plastic bolts and nuts.

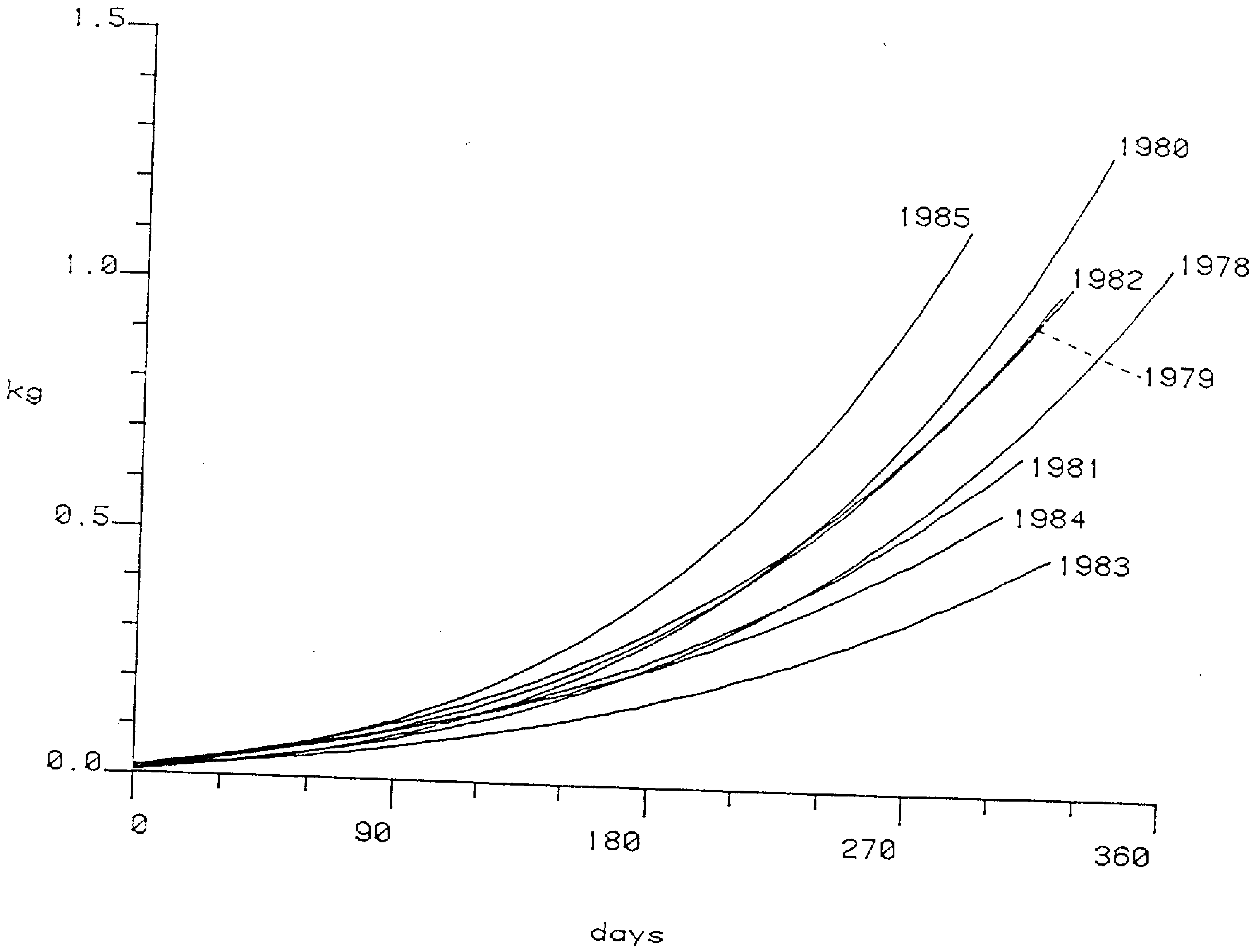


Figure 12. Fitted exponential growth curves for Kemp's ridley sea turtle (*Lepidochelys kempi*) year-classes 1978-1985 reared in captivity at the sea turtle head start research facilities, NMFS SEFC Galveston Laboratory, Galveston, TX.

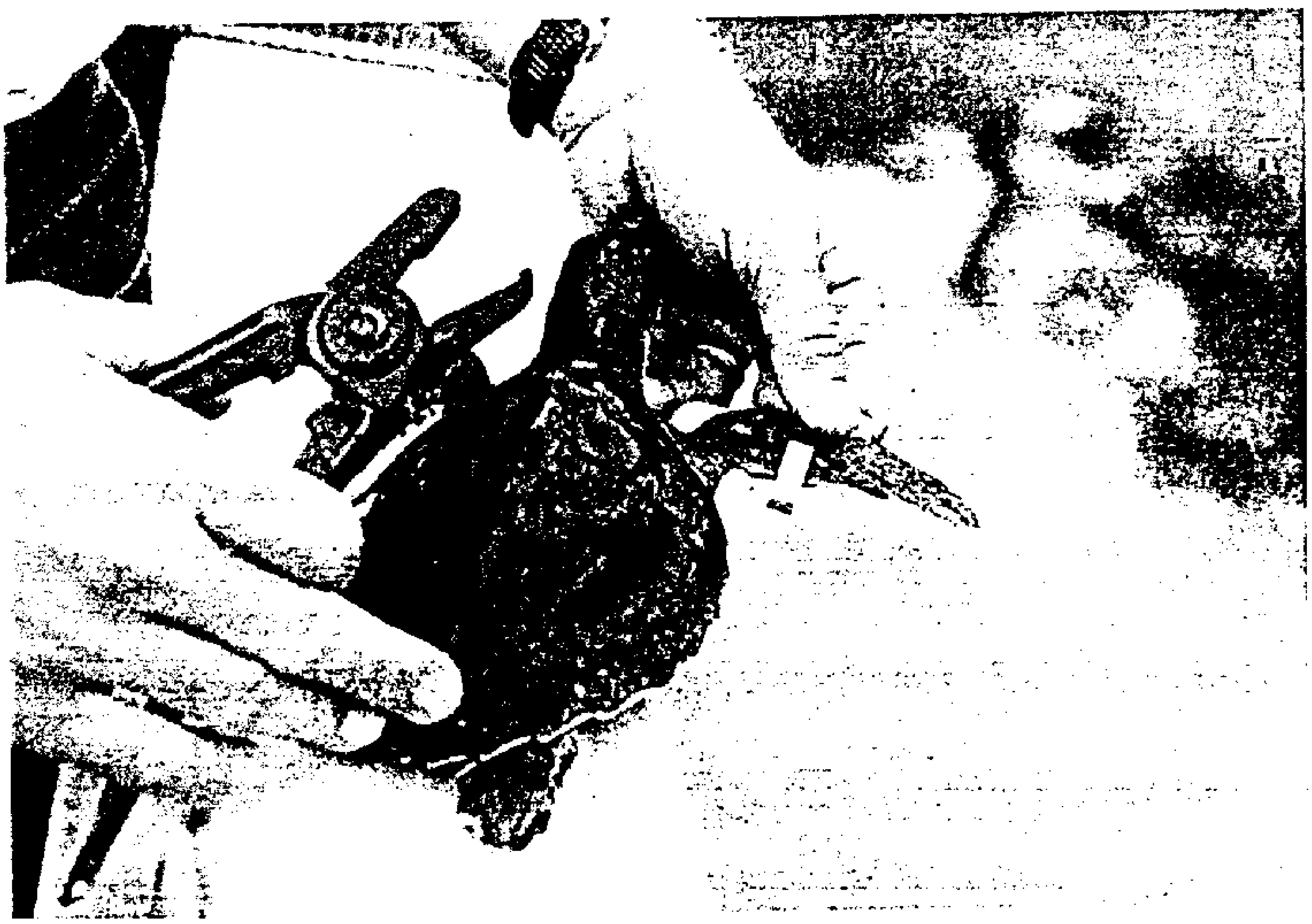


Figure 13. Metal flipper tag on a head started Kemp's ridley sea turtle (*Lepidochelys kempi*).